# Adding Wind Power to the Utility Generation Portfolio

Issues

Impacts

Benefits

## Is Wind Power a Prudent Investment?

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# Major Issues

- Costs (capital, energy, O&M)
- Variability Impacts (ancillary services costs)
- Transmission Requirements
- Environmental Benefits and Impacts
- Economic Development Benefits
- Customer Desires and Utility Response

# Wind Energy Cost Trend

**1979: 40 cents/kWh**

**2000:**
**4 - 6 cents/kWh**
(no subsidy)

- Increased Turbine Size
- R&D Advances
- Manufacturing Improvements
- Operating Experience

NSP 107 MW Lake Benton wind farm
4 cents/kWh (unsubsidized)

**2004:**
**3 - 5 cents/kWh**
(no subsidy)

# Natural Gas Situation

*Today's tight natural gas markets have been a long time in coming, and distant futures prices suggest that we are not apt to return to earlier periods of relative abundance and low prices anytime soon*

– Alan Greenspan, Federal Reserve Chairman, Testimony at Senate hearing, July 10, 2003

Wellhead gas costs - 2002-2003: $3 - $5/MMBTU

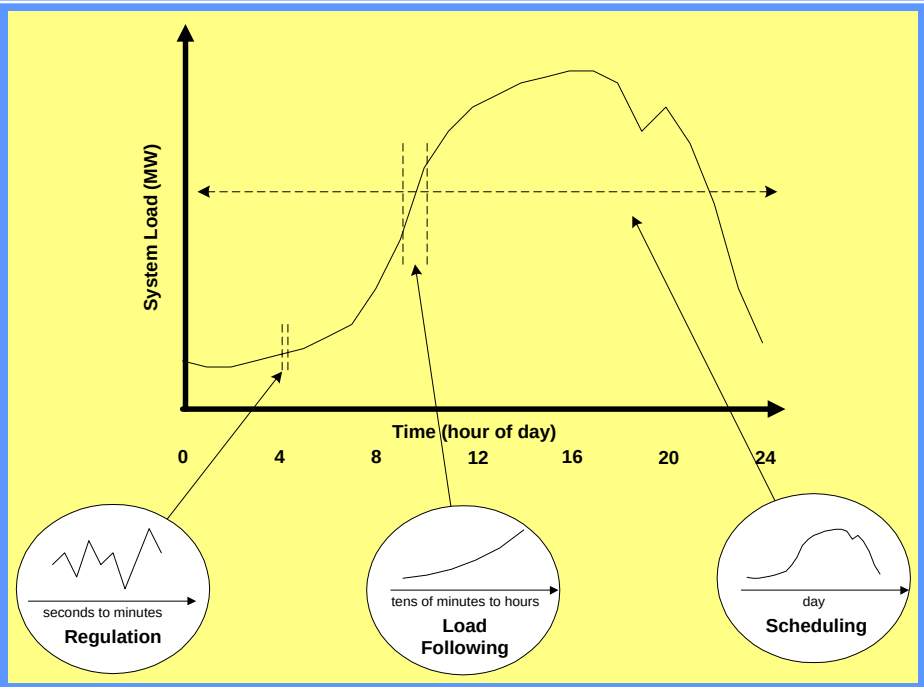
# Cost Comparison

- Installed Capital Cost: $1,000 - $1,100 kW today
- Energy cost: about 3¢/kWh (4¢ without PTC)
- 30-year levelized, 11% fixed charge rate (2003$)
- Includes 0.5 to 1.0¢/kWh for O&M
- Wind energy costs are ***stable*** over plant lifetime

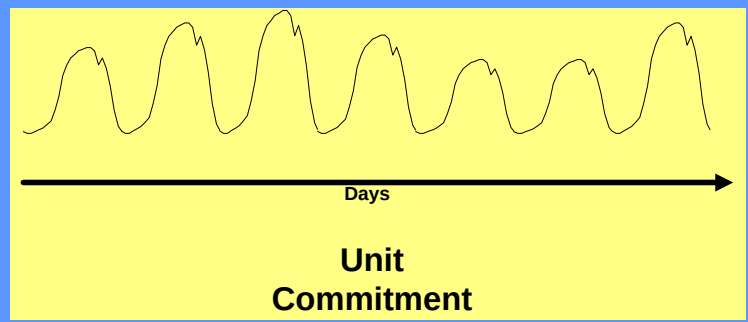
Natural-gas combined-cycle plant fuel cost (HR 9,000)

| $/MMBTU: | 2 | 4 | 5 | 6 | 8 | gas cost |
|---|---|---|---|---|---|---|
| ¢/kWh: | 1.8 | 3.6 | 4.5 | 5.4 | 7.2 | ***fuel only*** |

# *Wind Variability:* Power-System Operation Impacts




- Regulation -- seconds to a few minutes -- similar to variations in customer demand (loads)
- Load-following -- tens of minutes to a few hours -- usage follows predictable patterns, wind less so
- Scheduling and commitment of generating units -- one to several days -- wind impacts unclear




Wind controlled by nature, not power-plant operators!

# ***Wind Variability*** Can Increase Power System Operating Costs

- Committing unneeded generation
- Scheduling unneeded generation
- Allocating extra load-following capability
- Violation of system performance criteria
- Increased cycling operation
- **These are reflected in *ancillary services* costs**

Incremental cost added by wind's variability?
Utility Wind Interest Group case study:
$1.85/MWh of wind energy

# System Operating Costs Impacts: Results from Recent Studies ($/MWh)

| Study | Penetration (%) | Regulation | Load-Follow | Unit-Commit | Total Impact |
|---|---|---|---|---|---|
| UWIG/Xcel | 3.5 | 0 | 0.41 | 1.44 | 1.85 |
| Pacificorp | 20 | 0 | 2.5 | 3.0 | 5.5 |
| BPA/Hirst | 7 | 0.19 | 0.28 | 1.40 | 1.87 |
| We Energies (a) | 4 | 1.12 | 0.09 | 0.69 | 1.90 |
| We Energies (b) | 29 | 1.02 | 0.15 | 1.75 | 2.92 |

# *Wind Variability:* Impact on Transmission Access

Firm Transmission Rights

- Blocks for specified times
- Underutilized by wind
- Too costly

Non-Firm Rights

- Can be curtailed, but often OK for wind
- Not available long-term
- Insufficient assurance

Middle ground? Flexible-firm?

Wind-plant financing requires assured path to market

Transmission often contractually constrained -- ***but not physically***

# Transmission Requirements

- Good winds are often remote, so transmission is needed
- Cost of 50 to 100 miles of transmission may add only 10% to total wind plant cost
- Active debate over allocation of these costs
- Usually worthwhile to extend lines to access a good site
- But siting is a key issue

In general, transmission costs make up less than 10% of customers' electricity bills

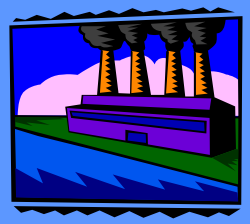
# Environmental Impacts

- Avian: raptors and migrating songbirds
  - Wind now: about 50,000 out of about 1 billion
  - Effective procedures to avoid problem locations
- Wildlife habitat
  - Some local issues
- Visual
  - Highly subjective
  - Concerns often subside after installation
- Property values
  - Studies show no negative impacts

We need to evaluate environmental impacts on a relative basis.
No energy-generation approach is without impacts.
The choice is wind vs. *something* -- not wind vs. *nothing.*

# Environmental Benefits

- No emissions of any kind during operation
  - No SOx, NOx, particulates or mercury
  - No contributions to regional haze
  - No greenhouse gases
- Environmental regulations will only increase
  - Wind hedges against these
- Global climate change is a serious concern to every major political entity worldwide except the current Administration in Washington, DC
  - Avoidance not politically sustainable in the U.S. or worldwide
- No concern about toxic wastes or health effects
  - Nuclear waste transport and storage unresolved
  - Respiratory diseases of growing concern



# What Does Energy Really Cost?

- Nuclear power
  - Federal government underwrites accident liability
  - Waste-handling costs significant and unknown
- Coal power
  - Respiratory concerns becoming prominent
  - $350 M/yr to coal miners with black lung disease
  - Recent *Science* article: health costs 2 - 4¢/kWh
- Oil and gas
  - Depletion allowances
  - DOD expenses to maintain supply channels

These costs are paid in tax and health bills -- not electricity bills. The federal Production Tax Credit (PTC) for wind compensates to a degree

# Economic Development Opportunities

- Land Lease Payments: 2-3% of gross revenue ($2500-4000/MW/year)
- 1-2 jobs/MW during construction
- 2-5 permanent O&M jobs per 50-100 MW,
- Local construction and service industry: concrete, towers, some electrical
- Local property tax revenue: 100 MW brings in about $500,000/yr
- Equity investors and lenders: returns on investment, interest payments
- Potential for manufacturing and assembly plants (e.g., blade factory in ND)

# Customer Views on Wind Energy and Utility Response

- Ask customers how they feel about renewables
- Solid positive response across the nation
- Can offer green-priced product in response
- Some utilities hide behind an unenthusiastic response to an expensive green product tentatively offered

Strong positive response from the customer base justifies addition and ratebasing of wind power

Almost everyone is willing to pay a small premium -- *and they may not need to!*

# Is Wind Power a Prudent Investment?

Affordable costs

Hedge gas price volatility

Operational synergy

Environmentally responsible

Economic development opportunities

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